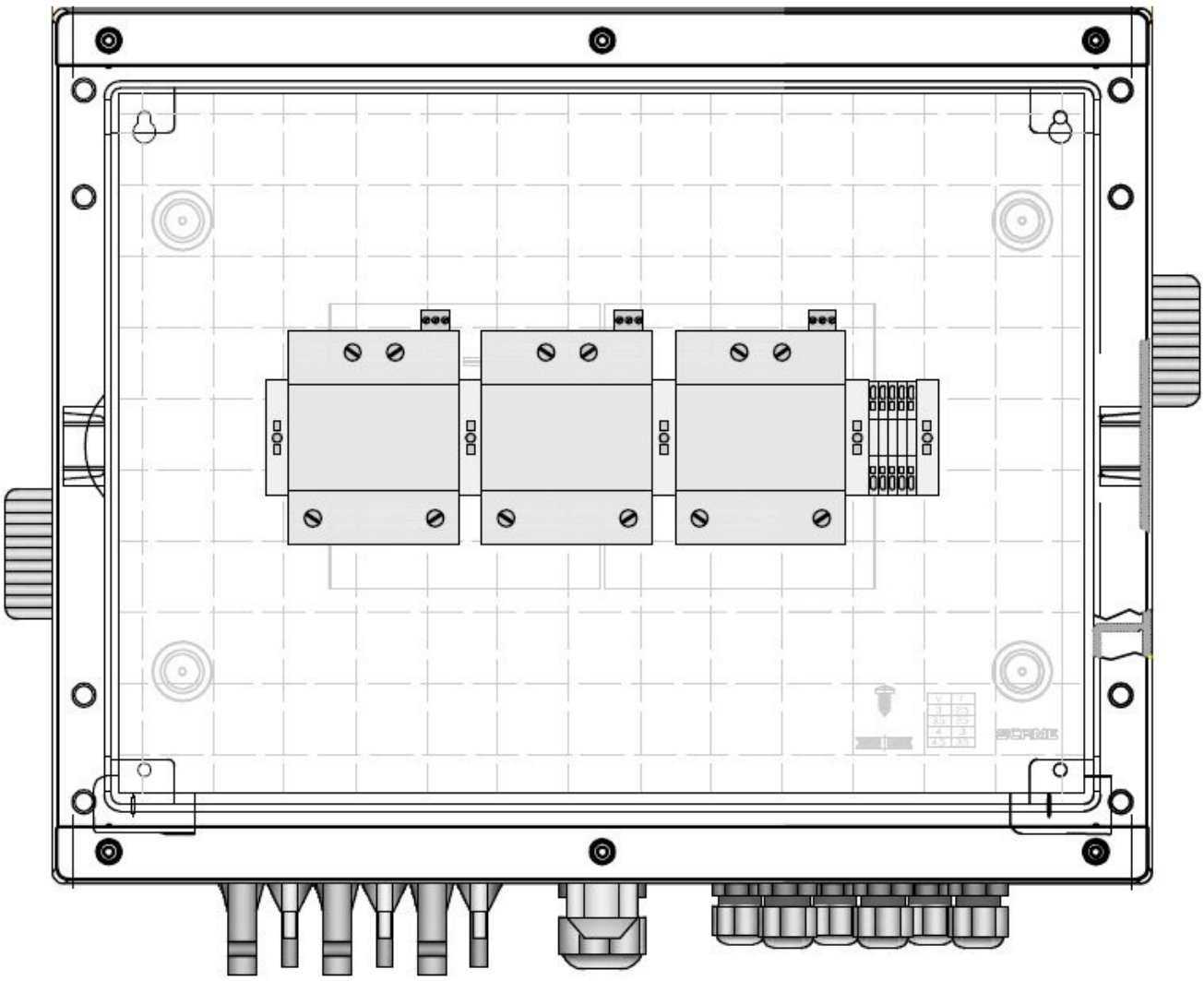
LPB DC3 Eco Lightning Protection

User's Manual



PHOTOVOLTAIK-TECHNIK
PADCON
Future technologies.

Edition 3.0

July 2011

Documentation History

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1.0	First Edition April 2011
2.0	June 2011: New logo
3.0	July 2011: Product name changed

Edition 3.0
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1. Introduction

1.1 Usage

The PADCON LPB DC3 Eco is a protection device against overcurrent and overvoltage by lightning. The LPB DC3 Eco is connected between the photovoltaic generators and the inverters. Overvoltage caused by lightning is discharged to earth as well from the plus line as the minus line. Thus the inverters installed behind the LPB DC3 Eco are protected against overvoltage.

3 strings (plus and minus) are protected against overvoltage by lightning by the LPB DC3 Eco.

The used arresters match highest market demands and therefore ensure maximum safety.

The LPB DC3 Eco is connected between the photovoltaic generators and the inverter and protects your inverter of the effects of a lightning stroke to your plant.
The LPB DC3 Eco is delivered with plant specific connectors.
The LPB DC3 Eco is delivered with an integrated roof and therefore is immediately applicable for outdoor installations.

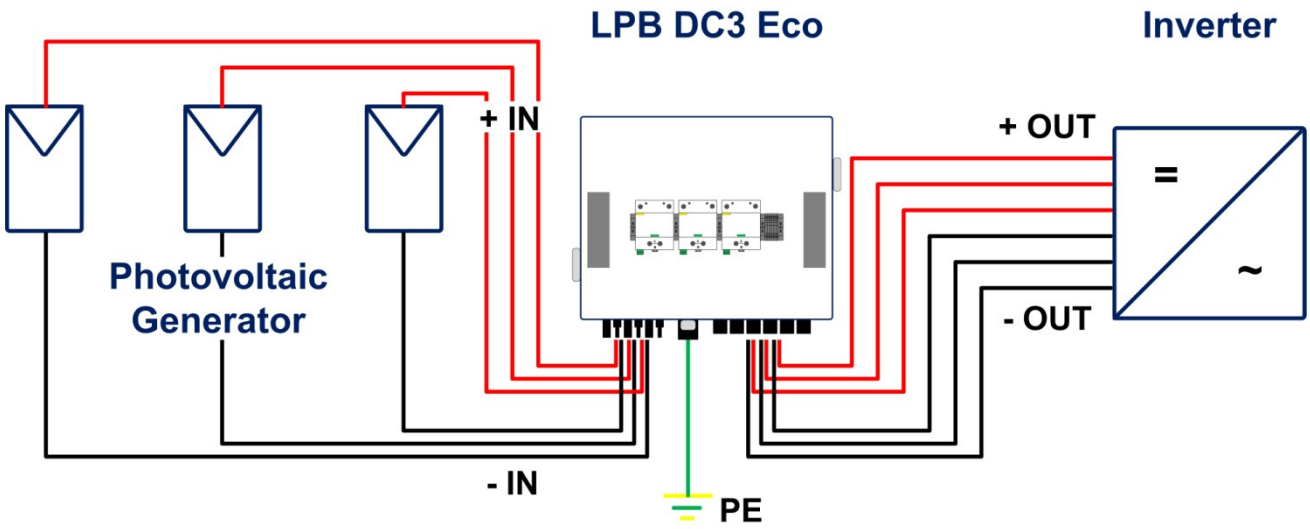
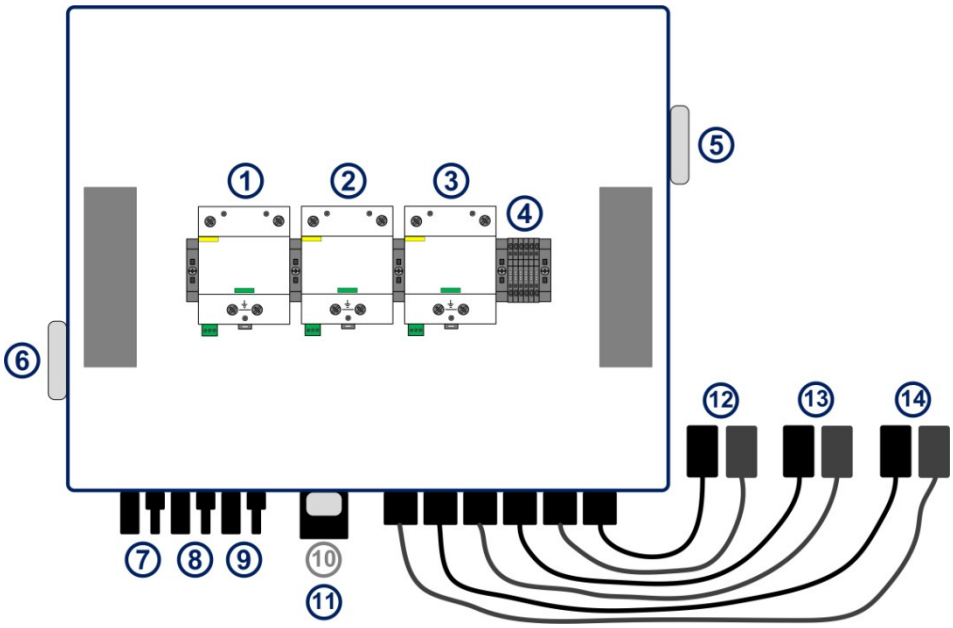


Figure 1: Overwiew

2. Product description / Delivery contents

2.1 Overview of the LPB DC3 Eco

LPB DC3 Eco - Components



Cypher	Number	Description
①	1	Combined arrester for string 1.
②	1	Combined arrester for string 2.
③	1	Combined arrester for string 3.
④	1	Terminal block for the combined arrester monitoring.
⑤	1	Pressure compensation.
⑥	1	Pressure compensation.
⑦	1 1	Plus input string 1: MC4 male receptacle (optional other connectors). Minus input string 1: MC4 female receptacle (optional other connectors).
⑧	1 1	Plus input string 2: MC4 male receptacle (optional other connectors). Minus input string 2: MC4 female receptacle (optional other connectors).
⑨	1 1	Plus input string 3: MC4 male receptacle (optional other connectors). Minus input string 3: MC4 female receptacle (optional other connectors).
⑩	1	Dewatering and ventilation plug.
⑪	1	Cable gland for the protective conductor (1m NYY-J, 1 x 16 mm^2).
⑫	1 1	Plus output string 1: 0.5m cable (ideal for Sunclix). Minus output string 1: 0.5m cable (ideal for Sunclix).
⑬	1 1	Plus output string 2: 0.5m cable (ideal for Sunclix). Minus output string 2: 0.5m cable (ideal for Sunclix).
⑭	1 1	Plus output string 3: 0.5m cable (ideal for Sunclix). Minus output string 3: 0.5m cable (ideal for Sunclix).

Table 1: LPB DC3 Eco - Components

2.2 Delivery contents

- LPB DC3 Eco
- User's Manual
- 1m NYY-J, 1 x 16 mm^2, protective conductor (already connected to one side)

3. Technical data and documents

3.1 Specifications

HOUSING:	
Open field installation	Yes
UV resistance	Yes, conforming to UL 508
Material	Polymer plastic
Coloring	RAL 7035
Wall mounting	Yes
Leaded	Yes
INPUT:	
Maximum PV voltage [$U_{pv\ max}$]	≤ 1000 V
Input DC side	3- (MC4 female recetacles) / 3+ (MC4 male receptacles)
OUTPUTS:	
Outputs 3-/3+	3 minus outputs: 0.5 m cable 3 plus outputs: 0.5 m cable
Nominal output current [I_{Nom}]	30 A
Earth connection	NYY-J 1x16 mm^2 cable, 1 m total length
DIMENSIONS AND WEIGHT:	
Housing width/height/depth [mm]	460 / 370 / 245
Weight	5 kg
STANDARDS:	
CE conformity	Yes
PROTECTIVE CLASS AND ENVIRONMENTAL CONDITIONS:	
Protection class conforming to EN 60529	IP 65
Valid surrounding temperature (T in °C)	-40 °C…+50 °C
Rel. air humidity non condensing (U_{Air})	Up to max. 90%
Max. height over mean sea level (MSL)	2.000 m
FURTHER PROPERTIES:	
SPD according to EN 61643-11/ EN 61643-11	Type 1+2 / Class I+II / B, C
Nominal voltage (U_{ocstc}) $U_{n\ DC}$	1000V
Max. continuous voltage (U_{cpv}), $U_{c\ DC}$	1200 V
Max. discharge current (8/20) µs, I_{max}	40 kA
Nominal discharge current (8/20) µs, I_n	20 kA
Lightning impulse current (10/350) µs, I_{imp}	12.5 kA
Protection level for In, U_p	< 2.8 kV
Protection level for 5 kA, U_p	< 2.3 kA
Protection level for Imax, U_p	< 3.7 kA
Leakage current / operating current I_C / I_B	No
Follow current, I_f	No
Follow current extinguishing capability, I_{fi}	Infinite
Response time, t_A	≤ 25 ns
Short circuit resistance I_{PE}	25 kA

3.2 Dimensions of the LPB DC3 Eco

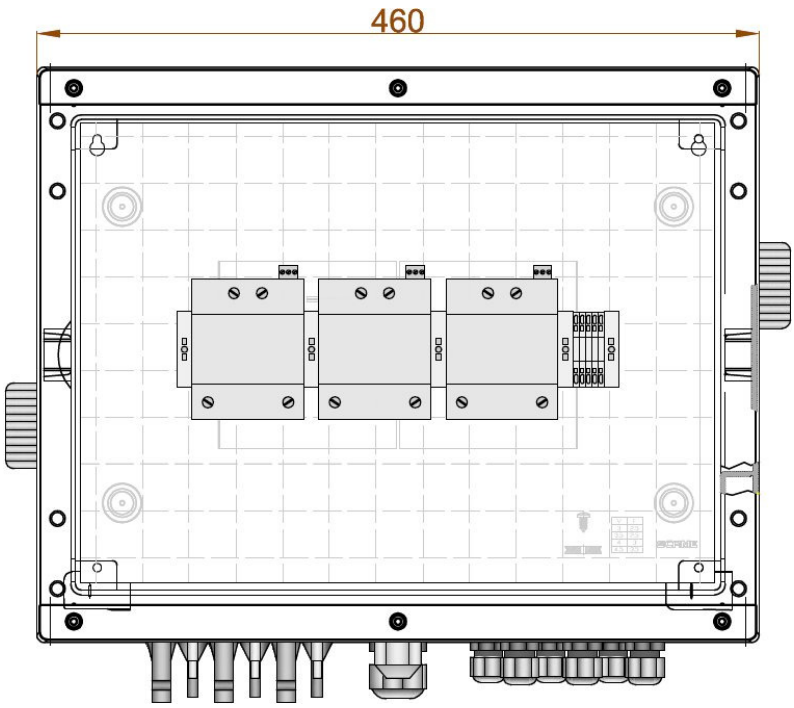


Figure 2: Front view

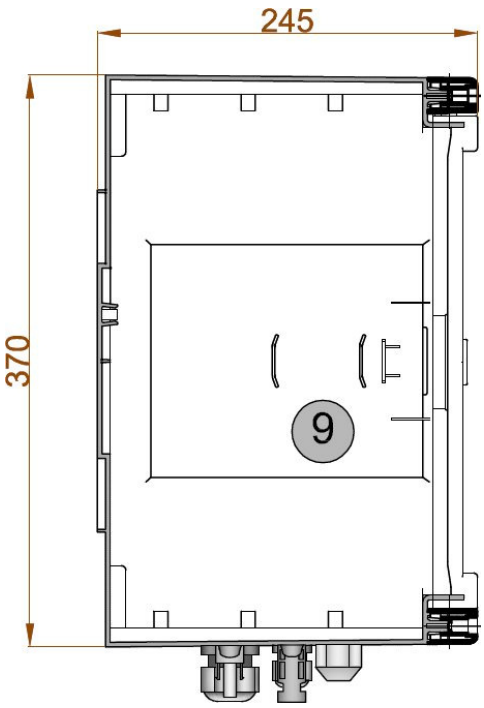


Figure 3: Side view

4. Installation / Connection

Danger:
Danger of life by electrical shock !

High DC voltages are attached to the different components of the LPB DC3 Eco.

- All works described in this manual must exclusively be executed by qualified technical personal. Qualified means that the personal has to be trained corresponding the task that has to be executed.
- All safety instructions mentioned in the user's manual have to be obtained working on the LPB DC3 Eco. The personal has to be familiar with the content of the user's manual.
- If you can not repair an error with help of this manual, immediately contact PADCON.

4.1 Installation

4.1.1 Place of installation

- Easily accessible.
- Connections have to be accessible.
- No constraining objects in immediate surrounding.
- Allow possibility for yearly maintenance (mowing the lawn, cleaning housings,…).

4.1.2 No direct weather influence

- Avoid direct, strong sun irradiation.
- Protect against direct rain.
- Protect against standing water.

4.1.3 Cable connection

- Cables to the bottom.
- Observe polarity.
- Retighten cable glands.

4.1.4 Installation of the housing

- Mount housing tension free.
- Avoid mechanical tension by screws.
- Adjust mechanical tensions with buffers if necessary.

4.1.5 Mechanical installation of the LPB DC3 Eco

- Solid and even mounting surface.
- Observe complete rest of the flange area of the optional available mounting brackets.
- Use all four fastening screws.

4.1.6 Horizontal mounting

- Check mounting and repair if necessary.

4.1.7 Realize drip off loop for inputs

- Imply reserve.
- No horizontal cable routing.

4.1.8 Cable conduct

- Avoid mechanical tension of inputs.
- Conduct cables without mechanical tension.
- Avoid crossings in wiring.

4.2 Electrical installation

1. Disconnect the inverter on the AC side.
2. Switch the inverter currentless on the DC side.
3. Mount the LPB DC3 Eco.
4. Connect the protective conductor (PE).
5. Connect the inputs of the LPB DC3 Eco.
6. Connect the outputs of the LPB DC3 Eco with the inverter.
7. Switch on the current on the DC side.
8. Put the inverter into operation.
9. We recommend to check the polarity and height of voltage of the strings before installation and to calibrate the input values of the inverter after installation.

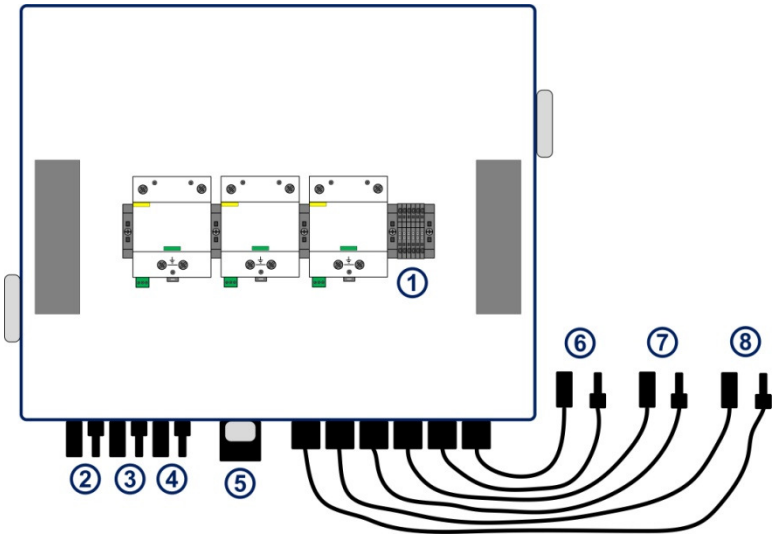
Danger:
The five safety rules !

The five safety rules:

- Disconnect
- Secure against restart
- Check absence of voltage
- Earth and short circuit
- Fence off and cover adjacent, live parts

LPB DC3 Eco

Terminal assignment – Connection description



① Terminal block: Combined arrester monitoring

Terminal no	Line description
1	Combined arrester for string 1: contact 1 (ncc)
4	Combined arrester for string 1: contact 2 (ncc)
2	Combined arrester for string 2: contact 1 (ncc)
5	Combined arrester for string 2: contact 2 (ncc)
3	Combined arrester for string 3: contact 1 (ncc)
6	Combined arrester for string 3: contact 2 (ncc)

② Input string 1 – MC4

MC4	Line description
MC4 male receptacle	Plus input string 1
MC4 female receptacle	Minus input string 1

③ Input string 2 – MC4

MC4	Line description
MC4 male receptacle	Plus input string 2
MC4 female receptacle	Minus input string 2

④ Input string 3 – MC4

MC4	Line description
MC4 male receptacle	Plus input string 3
MC4 female receptacle	Minus input string 3

⑤ Protective conductor terminal (PE) of the combined arrester

Terminal no	Line description
PE	Protective conductor clamping range: 1.5 - 25 mm^2. cable: 1m NYY-J, 1 x 16 mm^2

⑥ Output string 1 – MC4

Solar cable	Line description
1 x 6 mm^2	Minus output string 1
1 x 6 mm^2	Plus output string 1

⑦ Output string 2 – MC4

Solar cable	Line description

1 x 6 mm^2	Minus output string 2
1 x 6 mm^2	Plus output string 2
⑧ **Output string 2 – MC4**	
Solar cable	**Line description**
1 x 6 mm^2	Minus output string 3
1 x 6 mm^2	Plus output string 3

Table 2:

Caution:
The length of the protective conductor must not exceed 1 meter!

The length of the protective conductor must not exceed 1 meter (bus bar plus cable).

4.4 Tightening torques and conductor cross sections

Note:
Observe the tightening torques !

The tightening torques have to be observed during connection of the protective conductor (PE).

Conductor cross sections and torques		
Line	**Cross section**	**Torque**
Plus inputs	6 mm^2	-
Plus outputs	6 mm^2	-
Minus inputs	6 mm^2	-
Minus outputs	6 mm^2	-
Protective conductor	16 mm^2, screw terminal	10 Nm

Table 3: Conductor cross section

5. Function

The PADCON LPB DC3 Eco is a protection device against overcurrent and overvoltage by lightning. The LPB DC3 Eco is connected between the photovoltaic generators and the inverters. Overvoltage caused by lightning is discharged to earth as well from the plus line as the minus line. Thus the inverters installed behind the LPB DC3 Eco are protected against overvoltage.

3 strings (plus and minus) are protected against overvoltage by lightning by the LPB DC3 Eco.

6. Function check

Warning:
Do not open the LPB DC3 Eco !

The LPB DC3 Eco is leaded and must not be opened. In case of damage or destruction of the sealing expires the guarantee and liability by Padcon.

Refer to your supplier or to Padcon (www.padcon.de) for function check. The LPB DC3 Eco is leaded and must not be opened by unauthorized personnel.

6.1 Check of the connectors

6.1.1 Visual check

- Completeness of wiring
- Snap in of the clips
- Proper input wiring
- Proper fit of connectors
- Possible danger for man and material

6.1.2 Mechanical check

- Tight fit of connectors
- Tightening torque of cable glands
- Pull off test of connectors

6.1.3 Electrical check

- Check correct polarity
- Appropriate string current flow . See **7. Fault analysis / Decommissioning**.
- Appropriate open circuit voltage. See **7. Fault analysis / Decommissioning**.

6.2 Electrical check

- Polarity of the current direction
- Compare input and output current

7. Fault analysis / Decommissioning

7.1 Fault analysis

Fault analysis	
Visual inspection	
Fault description	**Measure**
Damage of the housing.	The LPB DC3 Eco has to be changed.
Damage of the cable glands.	The LPB DC3 Eco has to be changed.
Damage of the cables.	The LPB DC3 Eco has to be changed.
Damage of the male or female receptacles.	The LPB DC3 Eco has to be changed.
Damage of the dewatering and ventilation plug.	The LPB DC3 Eco has to be changed.
Damage of the pressure compensation elements.	The LPB DC3 Eco has to be changed.
Voltage check - Polarity	
Nominal voltage nonexistent.	The wiring has to be checked.
Polarity reversal.	Correct polarity.
Current check - Polarity	
The input current of the inputs has to be equal to the output current.	The wiring has to be checked.
Polarity reversal.	Correct polarity.
Ground fault error – Insulation fault	
Ground fault error.	The wiring has to be checked.

Table 4: Fault analysis

7.2 Decommissioning and demounting of the LPB DC3 Eco

Danger:
Danger of life by electrical shock !

High DC voltages are attached to the different components of the LPB DC3 Eco.

- All works described in this manual must exclusively be executed by qualified technical personal. Qualified means that the personal has to be trained corresponding the task that has to be executed.
- All safety instructions mentioned in the user's manual have to be obtained working on the LPB DC3 Eco. The personal has to be familiar with the content of the user's manual.
- If you can not repair an error with help of this manual, immediately contact PADCON.

1. Disconnect the inverter on the AC side.
2. Switch the inverter currentless on the DC side.
3. Disconnect the outputs of the LPB DC3 Eco from the equipment.
4. Disconect the inputs of the LPB DC3 Eco from the generator.
5. Disconnect the protective conductor (PE).
6. Demount the LPB DC3 Eco.

8. Safety instructions

General

1. **The LPB DC3 Eco only must be opened and installed by trained electrotechnical specialists**
2. **Consider the installation instructions in this manual**
3. **Consider the installation instructions of the used inverters and other connected devices**
4. **Consider the standards and rules as**
   - **BGV A1/A2: Common trade association safety instructions for electrical installations / equipment**
   - **DIN VDE 0100-712: Solar photovoltaic power supply systems (requirements for industrial premises, rooms and plants)**
   - **VDI 6012 VDI Guide line: Decentralised energy systems in buildings, photovoltaic**
   - **IEC 62548/ IEC82/514/CD: Installation and safety requirements for photovoltaic (PV) generators**
   - **DIN VDE 0100-534**
5. **Inspect the LPB DC3 Eco for damages before installation, that can prevent the functional and safety operation of the LPB DC3 Eco**
6. **In case of violation of the installation instructions mentioned in this manual expires the warranty and the liability**

Validity

This documentation describes how to install and operate a LPB DC3 Eco.

Target group

This documentation is intended for installers and operators of PV systems which are realized with the LPB DC3 Eco. It includes a description of how to install, operate the LPB DC3 Eco.

Explanation of the Symbols Used

In this document, the following terms and symbols are used to describe different hazard levels:

Danger

Danger indicates a hazardous situation which, if not avoided, will result in death or serious injury.

Warning

Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury.

Caution

Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Storage of documentation

This operating manual, the installation guide, the data sheets, the operating manuals of installed components, and the wiring diagrams must be kept in the immediate vicinity of the LPB DC3 Eco. They must be available to operators and maintenance staff at all times.

Failures and correction

Failures that can affect the safety, have to be removed immediately. Impermissible change and the use of spare parts, that are not recommended from PADCON can cause fire, material damage or electrical shocks. Unauthorized persons must nut have access to this devices. Instruction labels have to be readable properly and have to be replaced immediately if damaged.

Appropriate usage

Appropriate use of the LPB DC3 Eco means following all instructions in the installation manual relating to installation, electrical connection, and commissioning of the equipment. Any deviation from the instructions in this manual is regarded as inappropriate use of the equipment. PADCON accepts no responsibility or liability for any and all damage resulting from inappropriate use of the equipment.
Appropriate use of the equipment also entails:
• Observation of the safety instructions listed here and in the following sections
• Observation of the instructions in the user manual
• Conformance to the device-dependent technical data

Personnel

Only qualified technical personnel may perform any and all work on the LPB DC3 Eco. Qualified means that the personnel must possess training relevant to the activity performed and must be familiar with the content of this manual. The personnel must have read and understood the safety section in this manual.

About this manual

This manual was written with the greatest possible care. However, discrepancies cannot be excluded. PADCON accepts no responsibility or liability for injury to persons, or material damage caused by mistakes in this manual.

Checking the delivery

Upon receipt of the equipment, check the packaging and the device for any possible damage and compare the contents of the delivery with the delivery documentation. In the case of damage to the device and/or unclear delivery contents, please immediately contact PADCON GmbH (see contact address on the last page).

Storage

The PADCON LPB DC3 Eco may only be stored in rooms protected from dust and moisture.

Installation

The requirements relating to the installation site, the manner of installation and the mounting position must be observed. In addition to this, the following points must be noted.

- The installation location must be easily accessible and offer a secure base for working on the device. This is especially important for roof-mounted systems.
- The LPB DC3 Eco is built using the latest technology, according to recognized safety standards. Despite this, a fault resulting in arcing cannot be ruled out. This can result in melting of the enclosure as well as fire and smoke, which may represent a hazard to personnel or equipment. This must be taken into consideration upon installation.
- The equipment may not be installed near to inflammable materials. If this cannot be avoided, preventative measures must be taken, which prevent fire and smoke from spreading.
- The equipment may not be installed in critical areas, escape routes, living spaces or office spaces.

Special Hazards of Photovoltaic Systems

Photovoltaic systems have special characteristics representing special hazards that are described here. An active power source is connected, which means that depending on the operating mode there may be voltage present, from the photovoltaic generator and/or the LPB DC3 Eco. This is especially important to note when disconnecting the LPB DC3 Eco. High DC voltages are connected (no zero-crossing), that in case of error, or unproper use of fuses or connectors, may result electric arcs. The short-circuit current of the photovoltaic generator is only slightly higher than the maximum operating current and is also dependent on the level of solar radiation, which means that if a short circuit occurs in the system, the existing circuit breakers are not guaranteed to switch off. A highly branched generator array may be difficult to disconnect if a fault develops (e.g. short circuit). We recommend the additional use of the optionally available DC circuit breaker for disconnecting the inverter.

Changes, modifications or additions of the LPB DC3 Eco

Danger:
Danger in case of changes, modifications or additions of any components of the LPB DC3 Eco !
No changes, modifications or additions of any components of the LPB DC3 Eco are allowed without prior agreement of Padcon.

9. Maintenance

Danger:
Danger of life by electrical shock !

High DC voltages are attached to the different components of the LPB DC3 Eco.

- All works described in this manual must exclusively be executed by qualified technical personal. Qualified means that the personal has to be trained corresponding the task that has to be executed.
- All safety instructions mentioned in the user's manual have to be obtained working on the LPB DC3 Eco. The personal has to be familiar with the content of the user's manual.
- If you can not repair an error with help of this manual, immediately contact PADCON.

Following table gives an overview of the different maintenance working that have to be led through at the LPB DC3 Eco and the recommended maintenance interval.

LPB DC3 Eco - Maintenance	
Maintenance working	**Interval**
Check the terminal clamps of the string wiring for solidity and retighten if required. Visually check the insulation and the terminals. Thereby look after changes and discoloring of the material. Immediately change defect or corroded lines, contacts and connectors.	12 month
Check the correct and horizontal mounting of the LPB DC3 Eco.	12 month
Check the locks of the cover of the LPB DC3 Eco for free movement and correct function.	6 month
Check the cable glands for tightness and firm fit. Immediately change defect or untight cable glands.	6 month
Check if condensing water has accumulated in the LPB DC3 Eco.	6 month
Check the earth connection respectively the contact resistance of the protective conductor.	12 month
Check the climate elements dewatering and ventilation plug and pressure compensation for pollution respectively damage. The LPB DC3 Eco has to be changed in case of fault.	12 month
Check the mounting place of the LPB DC3 Eco for easy access, secure stand and flammable materials.	12 month

Table 5: Maintenance

10. Spare parts

Following spare parts are available for the LPB DC3 Eco:

- Male, female receptacle inclusively cable
- Combined arrester
- Mounting kit
- Cable glands
- Tools

11. Service / Contact

PADCON GmbH
Steigweg 24, Gebäude 44
97318 Kitzingen
Germany
Tel: +49 (0) 9321.2680-200
Fax: +49 (0) 9321.2680-9200
E-Mail: info(at)padcon.com
www.padcon.com

Service and Complaint

Your primary point of contact for any service issues is Sascha Machner with his competent team.

Tel: +49 (0) 9321.2680-222
e-mail: service(at)padcon.com